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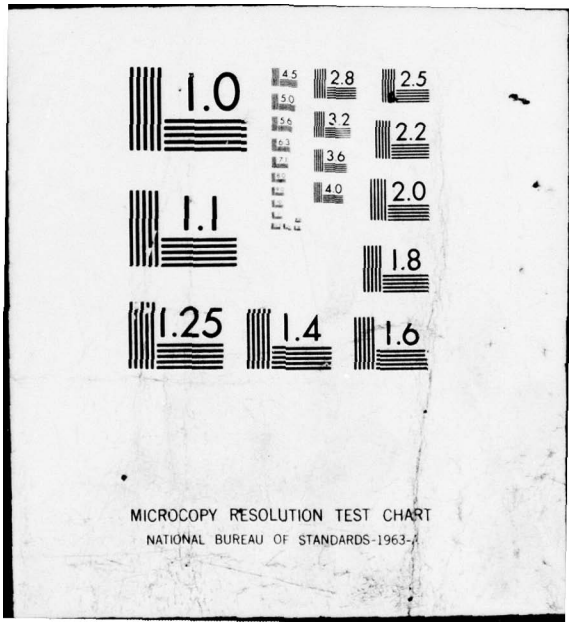
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MICRO-LEVEL APPROACHES FOR IMPROVING WATER RESOURCE KNOWLEDGE TRANSFER IN RURAL AREAS

BY

NATHAN BURAS

TECHNICAL REPORT SOL 77-12

JUNE 1977

Systems Optimization Laboratory

Department of Operations Research

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(See 1473)

Micro-Level Approaches for Improving Water Resource Knowledge Transfer in Rural Areas

by

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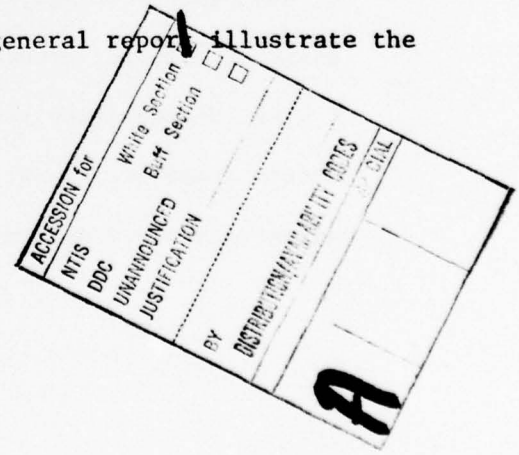
Introduction

The problem of transferring knowledge from its generating source in universities and research institutions to the various fields of application is not a recent one. In the field of water resources in its currently broad definition, one could perceive the appearance of this problem shortly after the publication of the first monography on the design of water resources systems [1]. Indeed, it took about a decade before some of the new principles and approaches developed in that monography became accepted tools for planning and design.

If the transformation of water resource knowledge into analytical and planning tools had to overcome obstacles, the transfer of this knowledge to the farmers and agriculturists who are using water as an input to their production processes is considerably more difficult. The papers reviewed and summarized in this general report illustrate the difficulties involved in this transfer.



The Papers

The six papers submitted to this session and summarized here cover a broad spectrum of issues: from a diagnosis of a difficult situation regarding the introduction of modern methods of water resources management and utilization at the farm level, to a theoretical alternative regarding the policy decisions relevant to such modernization efforts. These papers will be described briefly below.

1. A.C. Chaturvedi, "Information Dissemination of Water Resources in Uttar Pradesh".

   Detailed information regarding water and land resources in the state of Uttar Pradesh in India is given. This inventory is followed by a list of topics which are termed "research", but which are more in the nature of field investigations and surveys, necessary for an accurate determination of the physical and natural dimensions of the irrigated lands and of the water resources system. The paper then describes the faulty communication which exists between research and teaching organizations on the one side, and implementing and practicing agencies on the other, with the effect that results of research and planning experience are not disseminated.

   The paper proposes a number of solutions to this undesirable state of affairs, among which one may note the following.

   (a) Universities should be active in knowledge transfer. One should remember, however, that principles and methods developed in universities are seldom applicable directly to field conditions:

there must be established an intermediate step (such as experimental station) of a characteristic appropriate to the socio-economic environment in which knowledge is to be transferred.

(b) There seems to be a need in the state of Uttar Pradesh in India of a central body which would manage the further elaboration of knowledge generated in universities to a status of field usefulness. This body, similar to a state council for research and development, would foster the links between theory and practice.

(c) The International Water Resources Association (IWRA) should assume a global role for water resource knowledge transfer. One should be extremely cautious regarding direct transfer of knowledge in the water resource field on a global scale. Experience gained in one part of the world is the result not only of climatic, natural, and technical conditions prevailing there, but also of socio-economic, political, and cultural environment.

This paper presents a diagnosis of a difficult state of affairs which has no simple and immediate solution.

2. R.E. Dijon, "UN Activities for Improving Water Supply Conditions in Drought-Stricken Rural Areas of West Africa".

The drought which occurred in the Sahelian West Africa during the first half of this decade initiated certain activities by UN agencies, primarily by UNDP and UNICEF. One of the most acute problems was that of water supply and this paper summarizes some of the steps taken to alleviate water shortages.

Most of water supply in West Africa south of Sahara is derived from wells, which are of three types: (a) shallow wells in dry river beds, which are subject to destruction by floods; (b) moderately deep wells (to a depth of about 70 m), unlined; (c) wells lined with precast concrete pipe, which yield an amount of water greater than the other two types. The project launched by the combined UNDP-UNICEF team had two main outcomes:

(a) Well digging brigades were organized in six of the countries of this region, and their objectives were largely attained by the end of 1976. (In the Republic of Niger activities continued until May 1977.)

(b) In addition to these emergency measures, a program of construction of modern wells and of modernization of existing wells was launched. To date some 400 wells were installed totaling about 8,000 m, at a cost of $200/meter of excavation.

The UN-sponsored activities encompassed also additional tasks related to water supply, especially related to ground water resources. For example, large-scale drillings for ground water development were carried out in Mali, as part of a medium-term project covering the period 1975-1981. In addition, ground water studies and surveys were carried out in Mauritania, in the Cape Verde Islands, and in the Upper Volta where there are public health problems related to water supply. In the latter two countries, water resources studies were advanced toward overall planning and broader policy issues.

As a result of this varied activity, the UN established a regional office which began an inventory of wells, water points, and small dams. Preliminary results of this study indicate that West Africa south of Sahara needs some 10,000 additional wells, if water supply were to improve.

This paper indicates how an emergency situation was handled by international agencies, first developing a diagnosis and formulating the problem, then taking the first steps toward some immediate solutions and for longer range planning.

3. P.K. Buckles, A.W. Karp and B.W. Clemens, "The Training and Utilization of Rural Water Technicians in Guatemala".

The paper describes the conjunctive activities of two U.S. agencies--one governmental (USAID) and another nongovernmental (Agua del Pueblo)--and local authorities in Guatemala in the field of rural water supply and public health. A major characteristic of this program is that community involvement was sought in all stages: selection of projects, preparations and design, pre-construction evaluation, construction (through voluntary labor), and operation and maintenance of rural water supply systems. Another important characteristic is that the rate at which a project was developed was adjusted to the capabilities of the particular community involved in it.

Following the initial modest successes in transferring certain aspects of water resource knowledge to rural users, Agua del Pueblo

(ADP) plans to add two more elements to this program: (a) an improved approach to the financing of such rural projects; (b) training and employment of rural health technicians. As more distant goals, ADP considers the initiation of further community projects, such as schools and roads.

A key factor in the program of training and utilization of rural water technicians is that of qualified personnel willing to work in rural areas at reasonable rates of compensation. A danger is that over-qualified personnel, such as trained engineers, become very quickly high-level bureaucrats--hence useless. The attempted solution is to train local people with technical aptitudes willing to remain in rural areas.

A program (which the paper calls "methodology") for training such persons is suggested. The proposed program combines on-the-job training with elements of medium-level vocational schooling, for the purpose of producing Tecnicos de Acuaductos Rurales--TAR. Although the proposed program includes technical aspects of rural water supply up to water testing and quality control, as well community organization, socio-cultural aspects, and coordination with local agencies, it is not clear whether this program was agreed upon, or discussed with, the local Guatemalan people.

The training program itself is still in its development stage, to be completed by next September. Then a three-year testing period is expected to begin next year.

The paper indicates a promising and partly successful approach to the thorny problem of transfer of water resource knowledge at the micro level.

4. R.C. Holmes, "Irrigation Water Use in the Arequipa Region of Southern Peru".

Modern irrigation methods were introduced in a project of 30,000 hectares in the arid zone of Peru (average rainfall--15 mm annually); then these methods had to be abandoned in less than one year, the irrigation system reverting to more primitive practices.

The project was designed for family-size farms (10 hectares each) so as to provide employment for the entire family. Two major errors apparently were committed in this project: (a) the traditional irrigation practices were ignored; (b) all the operations related to the land preparation and to the operation of the irrigation scheme were done by the same agencies, with personnel imcompletely familiar with the socio-cultural conditions of the settling farmers.

The characteristics of the irrigation system were as follows:

(1) the on-farm distribution system consisted of concrete-lined ditches;

(2) the main irrigation method was border strips;

(3) water was conveyed from the head ditch to the border strip by means of plastic syphons.

Apparently insufficient contact between the planning and operating agency and the farmers themselves resulted in the abandonment by farmers of the syphons and the reversal of the irrigation practice to wild flooding. With the abandondment of syphons, holes were punched into the ditch walls, to enable the water to flow from the

the supply ditch into adjacent borders. However, since the soils in the area were mostly light-textured demanding close control of applied water, wild flooding caused serious erosion problems. Furthermore, the water delivery to the farms was on a rotational basis, so that some irrigation had to be done at night. More often than not, night irrigation of wildly flooded borders turned out to be a disaster. Within less than one year, the extension agents of the organization which built and operated the system left the area.

This paper illustrates an almost complete failure in the transfer of knowledge at the farmer level in the area of water resources. The result was more than an outcome of "Murphy's law": the lack of contact with the population involved in this project contributed probably the greater share of this fiasco.

5. P. Rosenfield, R.J. Saunders and J.J. Warford, "The 'Appropriate Technology' Bandwagon: Transfer of Knowledge and Community Water Supply".

The thesis of this theoretical paper is that "appropriate technology"--that which should be transmitted to the developing community--can be determined primarily (if not exclusively) by standard economic shadow price techniques.

A substantial part of the paper is oriented toward a critique of Schumacher's "appropriate technology" approach. The paper states that this approach is based on two concepts:

--the technology should be appropriate for the setting in which it is used (it would be hard to dispute this concept);

--traditional economic analysis is not sufficiently responsive to the needs of the poor (this may very well be so: almost all physical and social concepts have a finite range of applicability; it is quite possible that traditional economic analysis may not be responsive at either extremes of the socio-economic spectrum--the very rich and the very poor).

The transfer of knowledge in community water supply is viewed as a problem in optimal investment. The line of approach is to compensate in the short run for market distortions and to eliminate them altogether in the long run, thus attaining "proper investment decisions." This can be done via shadow price analysis, which can include also cultural criteria, religious taboos, educational levels, and social needs. However, this analysis requires a prior determination of "real resource cost" and estimation of benefits. In essence, the paper argues, transfer of knowledge is almost a special case of the more general problem of national resource allocation. In the specific case of community water supply, this problem has two objectives:

--to inform national policy makers about the positive aspects of eliminating market distortions;

--to encourage national policy makers to make decisions which are sometimes politically difficult, involving market prices which reflect the real resource costs to society.

In conclusion, the paper argues that knowledge transfer is more a matter of concern at the higher level of economic planning and political decision making, rather than at the lower level of technicians and extension agents.

This paper is a good example of theoretical unidisciplinary economic analysis. If the authors are criticizing Schumacher for his conclusions to be so general as to make it difficult to envision their specific application, one wish that this paper would include at least one example in which standard economic shadow price techniques were used, and a brief discription of the ensuing results. Until such an example from reality is presented, the approach proposed in this paper remains an interesting conceptual exercise--at best, an hypothesis yet unproven.

6. N.S. Grigg, "Water Resources Knowledge Transfer and the Development Process".

The paper postulates that knowledge is a commodity to be produced, processed, marketed, and consumed. One would have difficulties with the "consumption" aspect of this postulate, especially in the context of water resources where "consumptive use" of water involves the transfer of a commodity (water) from a controllable state (liquid) into an incontrollable state (vapor). Knowledge, however, after being produced, processed, and marketed, remains in a controllable state and is applied, adapted, updated, modified, and refined.

The paper defines "technology transfer" as a process by which a successful development of technological know-how built up in one institution is embodied as a way of doing things in other institutions. Thus, knowledge transfer has two dimensions: adaptation or utilization, and information dissemination.

The paper continues with an analysis of technology transfer, identifying four groups of participants:

--producers and processors of water resources knowledge;

--users (among which farmers may be the most important);

--elected and appointed officials (organizational echelon).

Transfer of water resources knowledge is further discussed in terms of problems it poses. Among them, one should consider also the following:

--*water resources systems are nuclei around* which many of the activities of regional development tend to converge;

--in order to be effective, water resources systems should be viewed as instruments for implementing socio-economic policies. In this context, continuous monitoring of the performance of water resources systems assumes a paramount importance.

The paper concludes with a number of policy issues, to which one may add that the planning of water resources systems is a continuous process requiring permanent multidisciplinary planning staffs.

Transfer of Water Resources Knowledge in Rural Areas

Two important points relevant to the transfer of water resources knowledge in rural areas were largely overlooked by the papers summarized

in this report: (a) the resistance to change exhibited by many farming communities at low levels of technical sophistication; (b) approaches to overcome such resistance. To be sure, the paper by Dr. Holmes described such a resistance to change, without, however, analyzing in too great a detail its major ingredients.

One could bring, nevertheless, at least two examples in which resistance to change was recognized--in Mexico [2, 3] and in Israel [4]--and one example of an attempt to overcome it.

The National Water Resources Plan of Mexico deals, among others, with the development of land and water resources in the tropical zone, mostly humid, along the coast of the Gulf of Mexico. One of the main points in this program is the establishment of new farming communities. In order to attain reasonable levels of efficiency in the proposed agricultural enterprizes, the National Water Resources Plan provides for the establishment of "Pilot Projects", as a necessary prerequisite for larger scale settlement activities. The purpose of the "Pilot Projects" is not only to disseminate agro-technical knowledge regarding crops to be grown in that region, but also to afford the prospective settlers an opportunity for developing organizational frameworks and management approaches most suited to their own cultural and social backgrounds. The activities of the "Pilot Projects", which were established fairly recently, are currently under way, and it is hoped that preliminary evaluations will be shortly forthcoming.

The settlement effort in Israel a quarter of a century ago is an example of yet a different approach at the micro-level in the

transfer of water resources knowledge in rural areas. Most of the new settlers had a very unsophisticated background, yet they were meant to become members of cooperative farming communities, in control of modern means of agricultural production. An important factor contributing to the success of this endeavor was the fact that experienced farmers from older and well established cooperative villages moved (some also with their families) into the new settlements. They lived side by side with the new settlers for at least one year, often for longer periods, performing the double task involved in knowledge transfer--dissemination of information and technology adaption. However, this effort would not have been possible if there were no ideological motives which prompted the more experienced farmers to come to the assistance of the less knowledgeable ones. Indeed, the ideology pervaded, at that time, not only most of the farming community, but the entire organizational and bureaucratic structure from the top government to the last extension agent.

Conclusion

Improvement of water resource knowledge transfer at the micro-level in rural areas is an essential task in increasing the world food production and improving food distribution. It involves a blend of many activities, from the application of rigorous analytical techniques to the development of ideological bases. Unfortunately, there are no simple, instant answers to this intricate problem.

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Abstract

One of the topics discussed at the Second International Conference on Transfer of Water Resources Knowledge (Colorado State University, Fort Collins, Colorado, June 29 - July 1, 1977) dealt with utilization of water resources knowledge in the context of regional development. Six papers were presented to the conference under this heading covering a broad range of issues: from a diagnostic description of a difficult situation in rural India, to a theoretical approach to the policy decisions relevant to rural moder ization efforts. This general report summarizes the six papers, comments briefly on every one of them, then focuses on two key points which were by-passed by the papers: (a) the resistance to change of farming communities at lower levels of technological sophistication; (b) attempts to overcome this resistance.